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FACTS ABOUT
SLUDGE PROCESSING

A MASSACHUSETTS WATER RESOURCES AUTHORITY PUBLICATION – FALL 1996

For thousands of years, people all over the world have used organic wastes in agriculture. Before chemical fertilizers were developed in the 1940s and 1950s, one of the most common ways to fertilize farmland was to mix organic material – such as manure, crop residue and food wastes – into the soil.

Today, much of the organic waste people produce goes down household drains and into sewers, where it mixes with wash water, human waste, food scraps, stormwater and other debris. When this wastewater reaches a sewage treatment plant, most of the organic material – along with other solid matter – is separated from the water. The water is treated and discharged. The solids, called sludge, are then either minimally treated so that they can be landfilled or incinerated, or further treated and converted into a useful product, such as fertilizer. By converting its sludge for use in agriculture and landscaping, MWRA has become one of the nation's largest recyclers of organic material.

FROM SLUDGE TO BIOSOLIDS

When sewage sludge is processed in a way that it can be safely and productively applied to plants, it is referred to as "biosolids." Biosolids come in several forms, including liquid, cake, compost or heat-dried granules.

Today, biosolids products are in demand for soil enhancement and fertilization of farmland, nurseries, golf courses, parks, lawns and gardens. Biosolids fertilizers have been used successfully for years throughout the United States. Since the 1920s, Milwaukee, Wisconsin, has produced a fertilizer called *Milorganite*®, which has been popular with farmers, golf course superintendents and homeowners.

EGG-SHAPED DIGESTERS ON DEER ISLAND PRODUCE METHANE GAS FOR POWER GENERATION AND HEAT AS THEY BREAK DOWN WASTEWATER SLUDGE

IN THE FOREGROUND, A BARGE TIES UP TO A PIER AT MWRA'S SLUDGE-TO-FERTILIZER PLANT AT THE FORE RIVER STAGING AREA IN QUINCY.

MWRA PLANS FOR SLUDGE RECYCLING

Until December 1991, when MWRA closed and locked the valves that controlled sludge discharges and began operating its sludge pelletizing plant, hundreds of thousands of gallons of liquid sludge were released daily to Boston Harbor. As part of the Court Order in the federal Clean Water Act enforcement action brought by the U.S. Environmental Protection Agency and other plaintiffs to end Boston Harbor pollution, MWRA was required to end ocean disposal of sludge by December 31, 1991. As a result of the Ocean Dumping Ban Act of 1988, MWRA needed to develop land-based solutions for its long-term sludge management plan. The final plan, which received intense public scrutiny and reviews by state and federal environmental agencies, was based on drying to produce fertilizer, with landfilling as a backup.

REMOVING SLUDGE FROM SEWAGE

Like most modern treatment plants, the new Deer Island treatment plant will use both primary and secondary wastewater treatment processes to treat sewage. During primary treatment heavy solids fall to the bottom of large wastewater clarifiers (settling tanks), forming primary sludge. In secondary treatment, naturally-occurring microorganisms grow and feed on the organic matter in the wastewater creating a secondary sludge that settles out at the end of the process. The clear effluent is then disinfected and discharged, while the primary and secondary sludges are pumped to digesters for further biological treatment.

SLUDGE DIGESTION

At Deer Island, sludge digestion takes place in one of the country's first installations of state-of-the-art "egg-shaped" digesters. Each of the 12 digesters is 15 stories tall and can hold three million gallons.

The digesters use a process called anaerobic digestion, in which a warm, well-circulated, oxygen-free environment encourages the growth of microorganisms. Over a 20-day period, these "bugs" break down the raw sludge, reducing its volume, killing most pathogens and producing methane gas that helps fuel the treatment facility's power plant.

FROM LIQUID TO CAKE

Following digestion, the liquid sludge is barged from Nut Island and Deer Island to the Fore River plant for further treatment. Tanker barges will transport digested sludge until two 14-inch-diameter pipelines connect Deer Island with the pelletizing plant. The first leg of the pipeline has been installed as part of the five-mile inter-island tunnel. The remaining pipeline is presently being designed and is expected to be in place by 2003.

Since digested liquid sludge is still over 95 percent water, the first step in the process is to mechanically remove as much water as possible. Currently, belt filter presses use wide fabric belts to extract the solid material from the liquid and form it into "cake." The cake still contains 75 percent water and has the consistency of damp soil. In the future, the belt filter presses will be replaced by high-solids centrifuges, which operate at very high pressure to extract even more water.

FROM CAKE TO PELLETS

The cake travels by conveyor belts to dryer "trains." Each dryer train consists of a pug mill, a rotary drum dryer, a gas burner, product screens and air-pollution control equipment. The incoming cake is mixed in the pug mill with recycled dried product. The pug mill forms the mixture into small pellets that then enter the dryer. Operating at inlet temperatures between 600 and 1,000 degrees Fahrenheit, the dryer retains the biosolids pellets for about 30 minutes. The heat of the dryer kills the remaining bacteria and pathogens to below detectable levels, making the product safe for general use.

When the pellets leave the dryer, they range widely in size. Screens sort the pellets into those of desired product size and those to be recycled. Finally, pneumatic tubes convey the biosolids fertilizer into storage silos. Rail cars can be brought directly under the silos for loading and shipment to customers.

THE PRODUCT

The final product is a small, hard pellet that is approximately 60 percent organic matter and contains several important plant nutrients, such as nitrogen, phosphorus, calcium, sulfur and iron. The nitrogen in the fertilizer is in an organic form, which means that it must be broken down by soil microbes before it can be taken up by plants. This is a desirable feature in many settings, where "slow release" nitrogen feeds the plants at a gradual rate, while minimizing the risk of nitrate pollution that some synthetic fertilizers pose. The organic matter in the biosolids is also valuable because it can help improve the moisture-holding capacity of some soils.

To ensure product quality, the fertilizer is sampled daily and analyzed by state-certified laboratories. Biosolids fertilizers are subject to federal regulations governing the use of sludge-derived products, as well as state fertilizer and biosolids regulations.

MWRA's processing plant is currently run by a Massachusetts-based contract operator, New England Fertilizer Co. NEFCO is also responsible for marketing the product. Most of NEFCO's customers are in the agricultural sector, including farmers who use the fertilizer "as is" on their

BAY STATE ORGANIC™

While New England Fertilizer Co. markets most MWRA-produced fertilizer in bulk, the Authority packages and distributes a small portion of the plant's output locally as ***Bay State Organic™***. The product is approved for use on lawns, landscaping and vegetable gardens.

MWRA introduced the product in 1994 with a free-fertilizer program. From a Natick, MA distribution facility and from auxiliary points in several of its customer communities, MWRA gave away 1,300 tons of ***Bay State Organic™*** that season. Most recipients were individual homeowners, although many landscapers, institutional turf managers and others also took advantage of the offer.

In 1995, MWRA began commercial distribution of ***Bay State Organic™***. The fertilizer is now available at many retail locations. Several golf courses and landscaping companies also use it. In addition, MWRA gives the fertilizer to its customer communities for use on public property. ***Bay State Organic™*** has proved to be an excellent means of demonstrating the value of biosolids fertilizers and educating the public about an important aspect of wastewater treatment.

fields. Other customers are blenders who mix the fertilizer with additional ingredients and sell the blends to farmers. NEFCO also supplies manufacturers of turf and garden fertilizers, who combine the biosolids with other ingredients and sell it in bags. MWRA fertilizer has been used on citrus fruits, cotton, wheat, vegetables and turf in locations as diverse as Florida, Virginia, Indiana, Colorado, Arizona and, of course, Massachusetts.

MWRA produces about 15,000 dry tons of biosolids fertilizer each year. Production is projected to increase to over 60,000 dry tons annually when the new secondary treatment plant begins operating.

BENEFITS TO THE HARBOR

Ending sludge discharges to the harbor resulted almost immediately in demonstrably cleaner harbor waters. The disappearance of the sludge plume that for decades had discharged into President Roads shipping channel brought a dramatic improvement in the water's smell, appearance and clarity. Water-quality monitoring results indicated an almost immediate sharp decrease in fecal coliform levels near the old sludge-discharge site.

Free from sludge discharges, rocky areas of the harbor near former sludge outfalls began to recover, permitting characteristic New England species such as kelp, sea urchins, star fish and anemones to return. The health of flounder and other harbor fish and animals will continue to improve as the harbor cleanses itself.

MASSACHUSETTS WATER RESOURCES AUTHORITY

The Massachusetts Legislature created MWRA in 1985 to manage water and sewer services for 2.5 million people and 5,500 businesses in 61 communities. While the Boston Harbor Project is the best known of MWRA's projects, the Authority also maintains 400 miles of water pipes, aqueducts and tunnels, and 228 miles of sewers. Also underway are projects to control combined sewer outflows, provide adequate water delivery and meet all federal, state and local water and sewer standards.

THE BOSTON HARBOR PROJECT

MWRA's effort to control the pollution of Boston Harbor is centered around two programs: the Boston Harbor Project and the Combined Sewer Overflow Control Plan.

The Boston Harbor Project is a $3.4 billion, 11-year program to construct new wastewater treatment facilities at Deer Island. When completed at the end of the century, the project will ensure that wastewater discharges from 43 sewer-service communities meet all state and federal standards for protecting public health and the marine environment.

The project includes a new primary and secondary treatment plant on Deer Island; a headworks on Nut Island; a five-mile long tunnel connecting the headworks with the treatment plant and related facilities. A new 27-foot-diameter, 9.5-mile-long tunnel will discharge treated wastewater through 55 diffusers into Massachusetts Bay, ensuring that the effluent is well mixed with sea water.

The CSO Control Plan will reduce pollution from 81 CSOs in the region that can carry a combination of stormwater and sanitary sewage into the harbor and its tributaries during rainstorms. The completed project will reduce the volume of CSO flows by 84 percent over 1988 conditions and provide screening and disinfection to 96 percent of the remaining flow. Many outfalls will be closed or diverted. The plan will result in significant water quality improvements.

MWRA offers a wide variety of informational materials on the region's water and sewer systems and the natural environment. To find out what's available, contact MWRA's Public Affairs Department at:

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